

LEVEL II



Research Problem Review 78-16

**TRAINING EVALUATION OF THE INDIVIDUAL
STAFF USER ADP TRAINING PROGRAM IN
TCATA TEST FM 222 TACTICAL OPERATIONS
SYSTEMS (TOS) CONCEPT TEST**

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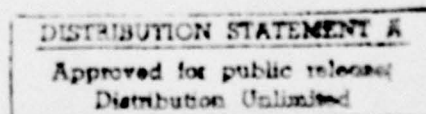


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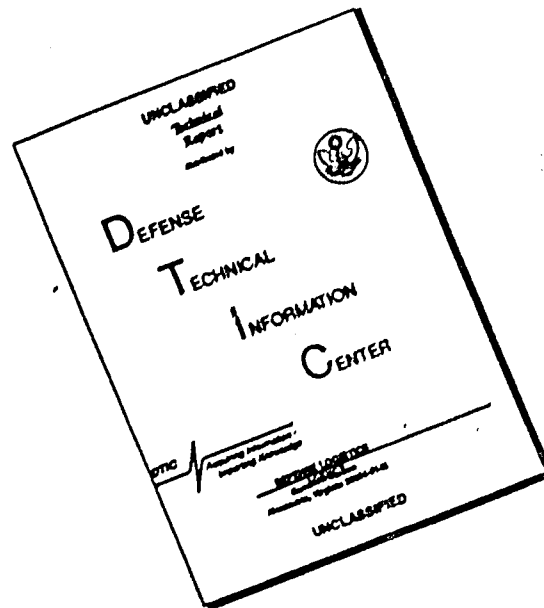


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OPERATIONS SYSTEM (TOS) CONCEPT TEST

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FOREWORD

→ This
[ADP] The Fort Hood Field Unit of the Army Research Institute for the Behavioral and Social Sciences conducts research under Army Project 2Q763743A775 and provides technical advisory service for the Training and Doctrine Command (TRADOC) Combined Arms Test Activity (TCATA). This report is responsive to a request by the Command Systems Test Directorate ~~of TCATA~~ for technical assistance in the conduct of the automatic data processing (ADP) training evaluation effort for the Tactical Operations System (TOS) Concept Test, TCATA Test FM 222. The U.S. Army currently has under development a number of automatic data processing [ADP] systems for employment in tactical missions. One of these is the TOS, which is designed to facilitate the Command and Control decision process by quickly gathering, analyzing, and disseminating tactical information to field commanders in sufficient time to allow quick reaction to rapidly developing tactical situations.

The purpose of the TOS ^(ADP) Concept Test (FM 222) was to provide a data base to evaluate a concept of automated data processing assistance to the division staff. A limited system, called TOS Operable Segment (TOS²), was used as the test bed for conducting the test. The ADP training program was to provide all staff user personnel assigned to operate the TOS² with the knowledge and skills required to effectively perform their tasks during execution of the test. Findings from assessment of the TOS² staff user training program provided information for answering training evaluation objectives of the test.

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TRAINING EVALUATION OF THE INDIVIDUAL STAFF USER ADP TRAINING PROGRAM
IN TCATA TEST FM 222 TACTICAL OPERATIONS SYSTEM (TOS) CONCEPT TEST

BRIEF

Requirement:

To obtain data that permits assessment of the training requirements necessary for the division to employ TOS².

Procedure:

The training schedule consisted of 5 weeks of 4 hours per day. (The other 4 hours of each workday were spent in routine unit duties.) Performance, demographic, and opinion data were collected to answer the requirement. Performance data were obtained by means of end-of-training tests of trainees. Demographic and opinion data were obtained from questionnaires and training reports made out by the trainees and evaluators at the end of the main lessons, at the end of the training program, and at the end of the test. The data consisted of measures of operator performance in processing intelligence information on TOS² input/output terminals, and classification and rating scale scores, remarks, opinions, and observations concerning the training program. Descriptive and inferential statistical tests and techniques were used to analyze the data.

Findings:

The effectiveness of the training program was degraded by insufficient total hours allocated for training, the use of 4-hour rather than 8-hour daily training sessions, the compressed training schedule, and the dual commitment of students to classroom and unit duties. The effectiveness of the training program would be improved if the 5 weeks of 4 hours per day were changed to 2½ weeks of 8 hours per day. An expanded training program of 5 weeks of 8 hours per day should be considered.

The quality of instruction presented during training was rated as excellent. However, because the ratio of students to input/output devices was too high (3.3 to 1), training effectiveness was degraded.

Trainees rated the practical exercise method, which emphasized hands-on training, as more effective than the classroom-lecture method of training. The proper balance between classroom-lecture training and hands-on training must be determined by future research.

The proficiency level achieved by enlisted trainees was generally higher among those who possessed one or more of the following characteristics: previous functional background experience; the appropriate primary military occupational specialty (MOS 968, Intelligence Analyst); and higher aptitude scores in general technical (GT), combat, and surveillance and communications areas. The best single prediction of proficiency level was GT score.

Utilization of Findings:

This report was incorporated as part of TCATA test report FM 222 Tactical Operations System (TOS) Concept Test RCS ATCD-8, November 1977. Test results were employed as a part of the data from which to develop requirements and recommendations for a TOS at division and corps, which were presented to the CY 77 Army Systems Acquisition and Review Council II (ASARC II)/Defense Systems Acquisition and Review Council II (DSARC II).

TRAINING EVALUATION OF THE INDIVIDUAL STAFF USER ADP TRAINING PROGRAM
IN TCATA TEST FM 222 TACTICAL OPERATIONS SYSTEM (TOS) CONCEPT TEST

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TRAINING EVALUATION OF THE INDIVIDUAL STAFF USER ADP
TRAINING PROGRAM IN TCATA TEST FM 222 TACTICAL
OPERATIONS SYSTEM (TOS) CONCEPT TEST

INTRODUCTION

Advances in military technology have produced the means for conducting tactical operations at a much faster pace and intensity than was formerly possible. This acceleration of activity means that the command and control system must process more tactical information for decisionmaking but has less time for making decisions. There is an urgent requirement to gather large amounts of tactical information quickly, analyze the information, and disseminate it to field commanders for decisions and actions necessary for defense against rapidly developing threats. As this pace increases, manual methods become less effective for the necessary quicker reaction times.

The Army is aware of the problem and has been seeking to improve the tactical command and control system by using computer technology in the decision process. This approach is called the Tactical Operations System (TOS) concept, and it has involved an evolutionary, iterative process of interactive studies, tests, and software/hardware development efforts. The test discussed here was designed as an operational test of the TOS concept applied at the division level.

Test Purpose and Scope

The purpose of the test was to provide a data base with which to evaluate the TOS concept of automated data processing (ADP) assistance to the division staff, with emphasis on testing division staff's capability to use information input from selected volumes of intelligence and combat information from corps. Test results were to be used in developing requirements and recommendations for a TOS at division and corps.

The main part of the test was conducted as a series of command post exercises, using both the manual system and a computer system--the TOS Operable Segment (TOS²), a test-bed system designed to test the TOS concept. Participating command and staff echelons were selected elements of division, brigade, and battalion staffs. Control organizations simulated corps, direct support artillery battalions, and other division units. The test scenario placed the player division in reserve for approximately 48 hours and in contact with an enemy force for approximately 72 hours. Scenario events included a mix of tactical operations, command post displacements, continuity of operation conditions, command post displacements, continuity of operation conditions, and electronic warfare and security threats.

TOS² System Description

The TOS² is a limited application of automatic data processing of the tactical operations of a division in the field. It is a complete computer system consisting of an integrated assembly of ADP hardware, software, personnel, and communications designed to support G2/G3 operations within division headquarters. Tactical information is entered into and retrieved from a central computer through message input/output devices (MIOD) using variable-length, preformatted messages. Information from the system may be recorded in hard copy on the MIOD electronic line printer, displayed on the display editor, or portrayed graphically on the group display device (GDD).

The TOS² computer provides general services that include editing and validation, data access control, file maintenance, report generation, data base query, and automatic dissemination of information via Standing Requests for Information (SRI). In addition, there are specific processes associated with the three main functions automated in the TOS².

Enemy Situation (ENSIT). This function stores, retrieves, summarizes, and disseminates selected portions of the information utilized by intelligence elements in tactical operations. The categories of information include essential information about specific enemy units, their combat effectiveness, and history, plus spot report information concerning enemy activities, potential targets, losses, and other enemy situation data. Provisions are made for an intelligence working file and for the preparation and dissemination of an intelligence summary, as required.

Friendly Unit Information (FRENSIT). This function provides for the collecting, filing, display, and dissemination of the current status of friendly units assigned or attached to the division. The categories of information include location and tactical disposition of units; assignment of units within a task organization or task force; essential personnel, equipment, and supply status of units and task forces; and operations reports. FRENSIT contains the capability to prepare the division operations journal and situation reports.

FRENSIT/ENSIT (COMMON). The COMMON function supports both the FRENSIT and ENSIT functional areas by providing the capability to designate and identify Named Area of Interest (NAI) in the data base and monitoring Standing Requests for Information. When used with appropriate ENSIT or FRENSIT messages, the COMMON function enables the division staff to accomplish, to a limited degree, templating processes.

TOS² ADP Individual Staff User Training Program

Prior to testing, an ADP training program was conducted for division personnel who would operate the TOS² system; they were designated alternately as staff users, trainees, operators, or players. The program was designed to train staff users to employ the TOS² hardware and software applications that they would use in their duty assignments during the test. The program was developed and implemented by training personnel from Army Tactical Data Systems Command Systems Field Office (ARTADS-CSFO) and United States Army Combined Arms Center (CACDA). The course consisted of individual as well as unit training phases, but training evaluation was concerned with the individual training phase.

Individual ADP training was designed to provide selected player personnel with a general knowledge of the capabilities and characteristics of individual TOS² messages and functions and the basic knowledge and skills required to perform their staff duties in the test. The course of instruction was divided into FRENSIT and ENSIT training classes, in accordance with the staff functions automated in the TOS². The programs of instruction for the two classes were similar except that specific FRENSIT and ENSIT subjects were taught only in each respective class. Players were assigned to one of the training classes on the basis of the primary staff function they would perform in the test. Those with G3 functions were assigned to the FRENSIT class, and those with G2 functions attended the ENSIT class. The program of instruction is outlined in Table 1.

Training Evaluation Objectives

One test objective concerned training evaluation; the test was to obtain data that permitted assessment of the training requirements necessary for the division to employ TOS². Of primary interest was evaluation of the effectiveness of the TOS² ADP Individual Staff User Training Program. One aim was to determine (a) whether or not this instruction was adequate for preparing the trainees to meet the program objectives and (b) how effectively the program had been carried out. The other aim of the evaluation was to ascertain if the trainees had accomplished the program objectives at the end of training. A related interest was identification of individual aptitudes or characteristics that could be used as variables for predicting success in TOS² ADP training. The variables could be used as criteria for selecting trainees for assignment to ADP training. The present evaluation was undertaken to investigate these problems.

Table 1

TOS² ADP Individual Staff User Training Program of Instruction

Title	ENSIT	FRENSIT
	class S2/G2 (hours)	class S3/G3 (hours)
Introduction to Staff User Course (TOS ²)	4	4
TOS ² Demonstration	1	1
MIOD Operating Procedures	2	2
Assembly/Disassembly of Cabling	4 ^a	4 ^a
Digital Data Terminal	2 ^a	2 ^a
Operator Maintenance/Trouble Shooting	2 ^a	2 ^a
Communications Methods	4 ^a	4 ^a
ADP Tactical Applications	4	4
Introduction to TOS ² Messages	6	6
Examination (Introduction to TOS ² Messages)	4	4
ENSIT Files, Formats, Applications, and PE	24	0
FRENSIT Files, Formats, Applications, and PE	0	34
Examination (FRENSIT/ENSIT, Files)	4	4
Templating	2	2
Continuity of Operations (CONOPS)	2	2
Discussion of Brigade Relay	2	2
File Managers	2	2
Staff Interface in TOS ²	6	6
Applications Review	2	2
Graphic Application	8 ^b	0
Functional Applications	18	18
GDD Operations and Maintenance	8 ^b	0
File Manager	2 ^c	2 ^c
Total Hours	123	105

^a Only Selected MIOD Operators received these classes.^b Intelligence personnel of A&P only received this instruction.^c Given only to personnel identified as file managers.

METHOD

Trainees

In all, 103 officer and enlisted personnel from the First Cavalry Division and a military intelligence battalion from III Corps were assigned as players in the test and as trainees in the ADP training program. The backgrounds and abilities in the heterogeneous group varied widely. Formal education ranged from 9 to 17 years. Military grade ranged from E2 to O5, and time in service ranged from a few months to over 20 years. Almost all the officers had occupational specialties in either combat arms or military intelligence, and large proportions of enlisted soldiers had either a combat arms military occupational specialty (MOS) or an intelligence analyst MOS.

The training classes were integrated with all grades, and all trainees in each class received the same instruction. The FRENISIT class consisted of 24 officers and 27 enlisted personnel, totaling 51 trainees; the ENSIT class consisted of 15 officers and 37 enlisted personnel, totaling 52 trainees. This trainee mix in both classes, therefore, meant that there were wide variations in learning capability.

Questionnaires

Trainees were administered questionnaires at three points in the program: at the end of lessons covering major subjects, at the end of the training program, and after the test had been completed. The end-of-lesson questionnaires were oriented toward obtaining trainee opinion concerning the quality of training and how well the lessons had been taught. The end-of-training and test questionnaires were oriented toward obtaining trainees' estimates of their level of training proficiency before and after the test.

End-of-Lesson Questionnaires. These questionnaires were designed to obtain information concerning the effectiveness of the main components of lessons covering the major subjects in the program of instruction. Each questionnaire contained four or five questions. Question 1 asked trainees to rate the instruction in accomplishing the lesson objectives on a 5-point scale from Very Effective to Very Ineffective. Question 2 called for a yes-no response to whether they had received enough instruction to fully understand the lesson objectives. Question 3, included for lessons having practical exercise sessions, called for a yes-no response to whether they were given enough hands-on practice with the equipment to learn the operator skills covered in the lesson objectives. Question 4 asked trainees whether they had accomplished all the lesson objectives and to indicate their judgment with a yes-no response. Question 5 presented the amount of training time spent on the subject and asked trainees to judge whether more, the same, or less time was required to learn fully the material covered by the

lesson objectives. Following the questions, space was provided for recording remarks and observations. Table 2 lists the training subjects covered by end-of-lesson questionnaires; these subjects accounted for approximately 70% of the training time in the program.

Table 2
Training Subjects That Trainees Evaluated with
End-of-Lesson Questionnaires

Subject	Training hours
MIOD Operating Procedures	2
Assembly/Disassembly of Cabling	4
Digital Data Terminal	2
Operator Maintenance/Troubleshooting	2
Communication Methods	4
Introduction to TOS ² Messages	6
ENSIT Files, Formats, Applications, and PE	24
FRENSIT Files, Formats, Applications, and PE	34
Functional Applications	18
File Manager	2
Total	98

End-of-Training and Test Questionnaires. These questionnaires were designed primarily to obtain trainee appraisals of their proficiency at the end of training and testing, and the relative amount of training time required to attain proficiency in each subject in the program of instruction. Question 1 consisted of two parts. In the first part, trainees rated their proficiency on each training subject, using a 3-point scale of Adequate, Borderline, and Inadequate. In the second part of Question 1, trainees made a relative judgment of the amount of training time required to attain adequate proficiency on each subject, when considering the time allotted to each subject in the training program; they used a 3-point scale of More, Same, and Less Time. Question 2 asked respondents to rate how effectively the individual and unit training prepared them to perform their duties in the test, using a 5-point scale that ranged from Very Effectively to Very Ineffectively. Question 3 requested the trainees to give their overall opinion of the training program, using a 5-point rating scale from Very Good to Very Poor. Question 4 asked for recommendations to improve the training program.

Evaluator Reports

The evaluators completed end-of-lesson reports of the lessons for all training subjects in the program. Supplementary reports contained recorded observations of trainee performance in the final examination and opinions concerning the overall training programs.

The evaluator end-of-lesson reports were designed to obtain evaluator judgments of the effectiveness of training provided for each subject in the program of instruction. Item 1 required the evaluator to rate the effectiveness of the training in terms of four components: lecture session, practical exercise session, instructor's teaching ability, and total lesson. Item 2 called for a yes-no response as to whether or not all lesson objectives were accomplished. Item 3 asked for the recording of all noteworthy observations and opinions.

Final Examination

A final examination for the training course was given at the conclusion of ENSIT and FRENSIT training. The examination consisted of a written part and a performance part. The written part was made up of a series of true-false and fill-in questions concerning basic knowledge of system functions and the preparation of TOS² messages. The items required an understanding of the characteristics of message formats, such as their uses, coding methods required for entering information correctly into message data sections, and system processes activated by message components.

The performance part of the examination was designed as a test of the primary objective of the training program. A set of performance standards was defined as the training criteria. The main criterion was that a trainee should be able to send a selected group of 10 messages representative of his section's ADP activities to the central processing unit within indicated time limits. All messages had to be accepted (without error) by the computer system. The test consisted of a series of 10 or 11 information requirements of different types that the trainee had to translate into the appropriate TOS² message format and correctly enter into the computer. Each trainee was seated at a MIOD by himself and given approximately 1 hour and 20 minutes to complete the task.

Demographic Data Survey

Demographic data were collected on the enlisted trainees in the ENSIT and FRENSIT classes; 24 biographical measures and aptitude scores were collected from the trainees and recorded from their personnel files. Table 3 lists the data elements collected.

Table 3

Biographical and Aptitude Measures Included
in the Demographic Data Survey

A. Biographical Scores and Measures

1. Grade
 2. Sex
 3. Age
 4. Civilian Education
 5. Time in Service
 6. Military Education
 7. Primary MOS Score
 8. Time in Primary MOS
 9. MOS Group
 10. School Trained MOS
 11. Typewriting Experience
 12. Teletypewriting Experience
 13. Key punching Experience
 14. Class Attendance in TOS² ADP Training
-

B. Aptitude Area Scores from the Army Classification Battery

15. CO (Combat)
 16. FA (Field Artillery)
 17. EL (Electronics Repair)
 18. GM (General Maintenance)
 19. MM (Mechanical Maintenance)
 20. CL (Clerical)
 21. GT (General Technical)
 22. ST (Skilled Technical)
 23. SC (Surveillance and Communications)
 24. OF (Operations and Food)
-

STATISTICAL ANALYSIS

The questionnaire data were analyzed with statistical tests of the goodness-of-fit type that tested the hypothesis that the samples of trainee responses were based upon experiencing an effective and efficient training program. A set of specified distributions was calculated for the items in the questionnaires to represent those that would be expected from a population who had received effective training in a well-run

program. The null hypothesis was that there was no difference between the observed trainee response distributions and the distributions specified for an effective training program. Statistical tests were made of the data to determine if there were significant differences between the observed proportions and the proportions expected on the basis of an effective training program. When the actual training program yielded results that were not as good as the criterion specified for an effective program, and where these differences were statistically significant, it was assumed that the actual training was not effective. The level of significance (alpha) selected for the tests was .05.

Two statistical tests were chosen for analyzing the questionnaire data. The chi-square one-sample test (χ^2) was used for analyzing data from items requiring yes-no responses, which produced two categories of data. The Kolmogorov-Smirnov one-sample test (D) was used for analyzing data from items calling for one of several choices falling along a continuous measurement scale.

A multiple regression analysis was run on the demographic data collected on the enlisted operator trainees to discover variables for predicting success in TOS² ADP training. Dixon's¹ computer program for stepwise regression analysis (R) was used for making all calculations.

STAFF USER TRAINING EVALUATION

The results are presented in four sections: staff user training, operator staff user training, commander and principal staff training, and analysis of demographic variables. The first section presents findings from the end-of-lesson ratings and evaluations; findings from ratings and evaluations made at the end of training and testing; and class attendance records and results from the final examination.

End-of-Lesson Ratings and Evaluations

Trainee Ratings. The staff user trainees were divided into two classes--an ENSIT class and a FRENSIT class. Each class had a course of instruction consisting of 10 subjects or lessons. The lessons for both classes were identical except for the central lessons, which covered ENSIT files and applications for the ENSIT class and FRENSIT files and applications for the FRENSIT class. The trainees rated 5 of the 10 lessons at the end of each lesson, which accounted for approximately 60 hours, or 79%, of the training. The five lessons not rated covered approximately 16 hours, or 21%, of the training. Table 4 summarizes

¹Dixon, W. J. Biomedical Computer Programs. University of California Press, 1975.

the results from the end-of-lesson questionnaires, listing the lesson titles and the instructional elements rated by the trainees.

Table 4

Trainee End-of-Lesson Ratings of Staff User Lessons

Lesson rated ^a	Instructional elements ^b				
	Training hours	Classroom training	Hands-on training	Attaining lesson objective	Lesson time
MIOD operating proc	2	S	S	S	S
Intro TOS ² messages	6	X	X	X	X
ENSIT applications	34	S	S	S	X
FRENSIT applications	34	S	X	X	X
Functional applications	16	X	X	X	S
File manager	2	--	--	--	--

^aLessons not rated: ADP doctrine (4 hr); CONOPS (4 hr); staff interface in TOS² (4 hr); graphic applications (2 hr); and GDD ops and maint (2 hr).

^bS = Satisfactory median rating.

^cX = Unsatisfactory median rating.

Trainee Opinions. Table 5 presents trainee comments on the end-of-lesson questionnaires about the two main subjects of instruction--ENSIT and FRENSIT files. Of these comments, 86% pertained to some aspect of the hands-on training, and 57% of these (49% of the total) pertained to the insufficient time that was devoted to hands-on training and practical exercises.

Evaluator Ratings. All lesson elements received a median rating of Effective for classroom instruction, instructor's ability, and the overall lesson. The practical exercise sessions were rated as borderline on all lessons, even though the lesson objectives were judged to have been accomplished.

Evaluator Observations. Generally, evaluator comments covered several problems and conditions that may have affected the training program. Conditions observed to have a negative effect on training were as follows.

Table 5

Trainee Comments on ENSIT and FRENSIT File Classes

Comment	Number times made	Percent distribution
More hands-on training with the MIOD's and more practical exercises (PE)	38	49
PE's inadequate in content and amount; they should be embedded in scenario problems so trainees can experience software interaction with message inputs and outputs	13	17
Less lecturing and classroom instruction	9	12
More varied training on the MIOD's	4	5
Too many students assigned to MIOD's during hands-on training	2	3
ADP training not necessary for evaluators	3	4
Structure training more toward specific positions	2	3
More emphasis on format instruction	2	3
More training on interaction of files, messages, and queries	1	1
Allot more time for teaching FRENSIT subjects	1	1
Replacements should be provided for students who drop out of training	1	1
Students should be on special duty status and released from all unit duties	1	1
Total	77	100

1. A high trainee-to-MIOD ratio (between 3 to 1 and 4 to 1);
2. A lack of enough assistant instructors during the early part of training;
3. A great range in the backgrounds and abilities of the trainees;
4. The doubtful effectiveness of using half-day training sessions (full-day sessions should be used);

5. The relatively low effectiveness of the combination of lecture and hands-on training that was used (a better balance between lecture and hands-on training is needed); and
6. Inadequate support from the trainees' unit commanders.

A condition observed as having a positive effect was the proficiency of the faculty, whose training and instruction quality throughout the training program were judged to be very high in all respects.

Trainee End-of-Training and End-of-Test Ratings, Evaluations, and Performance Measures

Trainee Ratings. Table 6 summarizes the results from the end-of-training and end-of-test questionnaires. The table lists the main lessons comprising the staff user training program.

Table 6

Trainee Ratings on Training Proficiency and Lesson Time

Lesson	End of training ^a		End of test ^a	
	Training proficiency	Lesson time	Training proficiency	Lesson time
MIOD operating procedures	X	X	S	S
ADP doctrine	S	S	S	S
CONOPS procedures	X	S	S	S
Intro to TOS ² messages	S	S	S	S
ENSIT applications	S	X	S	S
FRENSIT applications	S	X	S	S
Staff interface in TOS ²	X	X	X	S
Graphic applications	X	X	X	S
Functional applications	S	S	X	S
GDD ops and maint	X	X	X	S
File manager	X	S	X	S
ADP practical experience	-- ^b	-- ^b	X	X

^aX = Unsatisfactory median rating (less than adequate).
S = Satisfactory median rating.

^bNo ratings made on end-of-training questionnaire as it was administered subsequent to class training but prior to practical exercise.

On both the end-of-training and the end-of-test questionnaire, the trainees were asked to rate the effectiveness of individual and unit training in preparing them to perform their duties in the TOS² field test. On both questionnaires, the great majority rated the individual training as effective. On the end-of-test questionnaire, a significant proportion ($D = 2.43, p < .01$) of trainees, 40%, rated their preparation in unit training as less than effective.

The trainees were asked to give their overall opinion of the ADP training. On the end-of-training questionnaire, the majority rated it as good. On the end-of-test questionnaire, however, a significant proportion ($D = .169, p < .05$), 33%, rated the ADP training as less than good.

Trainee Recommendations. Trainees were asked to make recommendations for improving the training program. Their comments are given in Table 7 for the end-of-training questionnaire and in Table 8 for the end-of-test questionnaire. In general, approximately half the trainees' recommendations, 47% and 52%, were directed toward expanding or improving hands-on training, and another large proportion dealt with other aspects of the training. Overall, 76% of the recommendations on the end-of-training and 63% on the end-of-test questionnaires addressed the improvement of the training methodology. Another substantial proportion of the recommendations, 20% and 30% on the two questionnaires, concerned the overall course of instruction, pointed out weaknesses in the course content, and suggested changes for improvement.

Evaluator Ratings and Recommendations. The evaluators rated the effectiveness of the overall training program by observing class and test sessions and recording impressions of these proceedings. Their observations constitute a general assessment of program effectiveness and level of student proficiency at the end of the training.

In general, the evaluators stated that students showed a lack of familiarity with applying the methods and procedures for processing test problems, seemed somewhat disorganized in their efforts, and were slow and hesitant in feeling their way toward solutions. With few exceptions, the students used the maximum time for tests and even then did not complete all the problems. This result indicates a need for more practice in performance testing to develop the ability to detect and correct input errors. Evaluators also stated that students need exposure to test conditions during training, to develop the self-reliance and problem-solving skills and abilities required for ADP operations.

Class Attendance. Table 9 presents statistics of trainee daily classroom attendance for the two ADP training classes. Average classroom attendance for the G2 (ENSIT) and G3 (FRENSIT) classes was 90% and 83%, respectively. Of all trainees, 91% in the ENSIT class and 81% in the FRENSIT attended class at least 81% of the time.

Table 7
Trainee Recommendations at End-of-Training

Recommendation	Number made	Percent distribution
More hands-on, on-line training with the MIOD's in practical exercises.	32	27
Maintain a lower student to MIOD ratio, two-to-one maximum.	8	7
Increase practical exercises, minimize lectures.	6	5
Feature more difficult problems to be solved in practical exercises.	6	5
More assistant instructors to help students during practical exercises.	4	3
Have smaller classes.	6	5
Computer system breakdowns interfered with training; a backup computer would minimize these interruptions.	6	5
Lectures were too long.	5	4
Training day should be 8 hours rather than 4 hours.	4	3
Problem solving in message formats classes should be emphasized by making student select the correct format on the basis of how, when, and why.	4	3
A 5-week, half-day course is not adequate to train staff users; more training time.	3	3
Design training to be more self-paced, allow fast and slow learners to progress at their own pace.	3	3
Should be more written and performance tests.	3	3
Should be more training on message formats and more practice on writing formats.	6	5
Topics are too general and not oriented to the specific functions of the position, section leaders need more training on managing system problems and functions.	5	4
More training on the interpretation, inter-relations, and associations of various messages and queries.	4	3
Greater emphasis on SOP's and OFM's since they regulate ADP play.	3	2
Staff should be trained to function together.	2	2
User's manual and SOP should be better integrated and made more explanatory.	2	2
Need better SOP for CM&D, A&P, and ATSE on the subject of collection management.	1	1
The SOTAS needs a supplement.	1	1
Students should be assigned full time to ADP training (released from company duties).	4	3
Students should be assigned to TOS positions commensurate with their MOS.	1	1
TOTAL	119	100

Table 8
Trainee Recommendations at End-of-Test

Recommendation	Number made	Percent distribution
More hands-on, on-line training with MIOD's, using drills and practical exercises (PE's).	30	34
Expand scope of PE's to include operations tests of all sections, a complete FTX, a brigade TOC emphasizing staff and command interrelationships, and a CPX with division, brigade, and battalion.	6	7
Maintain a low student to MIOD ratio (2-to-1).	5	6
Improve quality of PE's and increase number of scenario problems.	4	5
Devote less time to lectures.	4	5
Improve system reliability to reduce interruptions of training.	2	2
More format training with the MIOD's.	1	1
In lectures, add demonstrations (examples) of individual functions.	1	1
Lectures were boring.	1	1
More performance tests with specific performance objectives.	1	1
More class time; training time is inadequate.	6	7
Give more training on following topics:		
Applying TOS ² principals and using system capabilities.	4	5
Interaction of files and processing functions.	1	1
System operational concepts.	1	1
Communication procedures, querying, and purging files, and on CONOPS.	1	1
Interaction between messages files ESD, EUS, and EUH.	1	1
FRENSIT formats UGS, GSR, and RPV reported on UTDA formats.	1	1
Communications wiring and troubleshooting.	1	1
FRENSIT subjects.	1	1
File manager subjects.	1	1
Division rapid reaction force (DRRF).	1	1
Battalion use of USMC and UTDS messages in changing situations.	1	1
Need better understanding by staff supervisors of ADP functions.	1	1
Generals and colonels need more training.	1	1
Need separate training programs for MIOD operators and staff.	1	1
MIOD operators need training to higher level of competence and ability.	1	1
Students should be assigned full time to ADP training (released from company duties).	3	3
Establish selection criteria for personnel for ADP training; essential they have operations experience.	3	3
TOTAL	87	100

Table 9
Trainee Classroom Attendance Records

Attendance record (percent)	ENSIT class		FRENSIT class	
	Frequency	Percent	Frequency	Percent
91-100	36	59	27	50
81-90	19	32	17	31
71-80	4	7	4	7
61-70	0	0	1	2
51-60	1	2	0	0
41-50	0	0	1	2
31-40	0	0	0	0
21-30	0	0	1	2
11-20	0	0	1	2
0-10	0	0	2	4
Total	60	--	54	--

Final Examination. Descriptive statistics of the cumulative frequency distribution of trainee scores on the written and performance parts of the final examination are presented in Table 10. Statistics on the cumulative frequency distribution of the number of messages processed correctly on the final examination are presented in Table 11. The mean number and mean percentage of messages processed correctly were 8.29 (83%) and 7.21 (66%) for the ENSIT and FRENSIT classes, respectively. Of the trainees, 60% of the ENSIT class and 49% of the FRENSIT class made nine or more correct message entries, which was the assumed system performance criteria required. Tests for significance of a proportion were made to determine if class performance satisfied the specification, and results showed that the percentage of students meeting the standard was significantly less than the hypothetical percentage of 84% for both the ENSIT and the FRENSIT classes (χ^2 proportion = 4.57, $p < .001$ for ENSIT and χ^2 proportion = 5.96, $p < .001$ for FRENSIT).

Discussion

The primary purpose of the training evaluation was to determine trainee proficiency at the completion of instruction. The training objective was to bring the students to a level acceptable for performance within system specifications during the testing phases of FM 222.

Thus, training objectives were used as the criteria for evaluating trainee achievement and the relative effectiveness of the instructional program.

Table 10
Trainee Scores on Final Examination

Raw score	Written			Performance		
	Frequency	Percent	Cumulative percent	Frequency	Percent	Cumulative percent
ENSIT						
91-100	38	64	100	27	59	100
81-90	16	27	36	11	24	41
71-80	3	5	9	4	9	17
61-70	2	4	4	3	6	8
51-60	0	0	0	1	2	2
0-50	0	0	0	0	0	0
Total	59	--	--	46	--	--
Mean	91.2	--	--	90.3	--	--
FRENSIT						
91-100	21	43	100	18	46	100
81-90	21	43	57	1	3	54
71-80	6	12	14	2	5	51
61-70	1	2	2	2	5	46
51-60	0	0	0	4	10	41
41-50	0	0	0	5	13	31
31-40	0	0	0	5	13	18
21-30	0	0	0	1	3	5
11-20	0	0	0	0	0	2
0-10	0	0	0	1	2	2
Total	49	--	--	39	--	--
Mean	89.1	--	--	70.8	--	--

Note. Standard deviation for ENSIT was 7.10 and 10.13 and for FRENSIT was 8.37 and 28.45.

Table 11
Messages Processed Correctly on Final Examinations

Number correct	ENSIT			FRENSIT		
	Frequency	Percent	Cumulative percent	Frequency	Percent	Cumulative percent
11	--	--	--	8	21	100
10	11	27	100	9	23	79
9	13	33	73	2	5	56
8	5	12	40	0	0	51
7	5	12	28	3	8	51
6	5	12	16	1	2	43
5	1	2	4	3	8	41
4	0	0	2	8	21	33
3	1	2	2	2	5	12
2	0	0	0	2	5	7
1	0	0	0	1	2	2
0	0	0	0	0	0	0
Total	41 ^a	100	--	39	100	--

Note. Standard deviation for ENSIT was 1.68 and for FRENSIT was 3.32.

^aDoes not include scores from five students whose message processing performance was obstructed by computer malfunction.

Trainee Evaluation. In the staff user training program, each staff user was required to perform an information-processing task by sending 10 basic types of messages to the computer within specified time limits. All messages had to be accepted by the computer, thereby indicating that the entry of all information elements was essentially correct. The evaluation criterion, therefore, was whether or not each trainee correctly entered 10 messages. The percentage of trainees who met this criterion was the empirical measure used to estimate the degree to which the training objectives were achieved.

If the criterion of 10 correct message entries is used, and other factors are not taken into consideration, then 35% of all the trainees achieved this standard. Examination of the distribution of scores for the ENSIT class (Table 11), however, reveals that one-third of that class made 9 correct message entries. The distribution of scores for the class is positively skewed and dichotomized between those making 9 and 10 correct entries and those making 8 or fewer. The 10-message

criterion does not conform to the dichotomy and does not reflect the natural division in performance differences brought about by the test. The distribution implies a doubt as to whether there are any real differences in proficiency between trainees making a score of 9 or 10 on the test, whereas there is more confidence that scores of 8 and 9 might indicate meaningful differences. A reluctance to exclude the trainees who had scores of 9 from consideration stemmed from the fear of making an error in judgment that might result from an appraisal that was in conflict with the dichotomous distribution of scores.

A criterion change to nine or more correct message entries expands the range to include all scores that could possibly meet the training objectives. When this criterion is applied, the results show that 54% of the trainees achieved the standard. This figure is believed to be a more accurate indicator of the extent to which the training objectives were achieved.

Program Evaluation. The assessment of program effectiveness involves considering the organizational goals that the program was designed to accomplish. If 100% criterion achievement was the desired organizational goal, then the program failed to attain its objective by a wide margin. On the other hand, when the program design is studied, it becomes obvious that the conditions necessary for total success were not established. The primary deficiency was the absence of any pretraining selection process to screen out individuals who lacked the potential to succeed. All individuals assigned to the program were accepted into it. A few of the trainees had no more than 3 or 4 months total time in service, and others had little understanding of G2 or G3 operations. These trainees did not have the necessary background knowledge for achieving the training objectives. The wide diversity in the trainees' experience, background, and ability was apparent to instructors and evaluators alike.

This situation carries the implication that the potential for achieving training objectives was a normally distributed variable among the trainees. This implication, in turn, tends to modify the goal of the training program. If it is assumed that trainee potential was normally distributed, and that the short-term, fast-paced training program was effective for training only trainees whose potential was at least as high as one standard deviation below the mean, then the maximum proportion of trainees that could be expected to achieve the training objectives would be about 86%. Considering the wide diversity in trainee ability, this level seems to be a more realistic goal. Assessing the program with this value increases the effectiveness rating to 64%; this latter figure appears to provide the most equitable estimate of the effectiveness of the training program. The assessment indicates that the program was fairly effective, but room for improvement remains. The problem of finding ways to improve program effectiveness will be taken up next by evaluating the strengths and weaknesses of the program.

Both trainees and evaluators gave consistently high ratings to the quality of the program of instruction and the teaching ability of the instructors on most of the lessons. The course content was well documented, in the form of a highly organized, extensively detailed staff user training manual supported with supplementary volumes of standing operating procedures (SOP). Trainees used the training manual continuously as a classroom text during lectures and as an operators' guide and reference during hands-on training. The subject matter was comprehensive and covered all aspects of the basic system operations with which staff users were involved. Most technical matters and staff user functions seemed to have been thoroughly covered. As an introductory course, the program of instruction was satisfactory in covering the basic functions. The only complaints concerned methods of performing in certain staff positions. The lectures were well organized, clearly presented, and comprehensible. The instructors had a good grasp of the subject matter and were able to provide satisfactory explanations for most of the questions raised by the trainees. During the lectures, instructors used slide projectors extensively as visual aids, which helped to clarify many procedural details. The lecture phase of training was used effectively for teaching the large volume of knowledge comprising the course content.

The trainee and evaluator ratings and comments clearly identified three major factors that combined to substantially diminish the training capability inherent in this program. The most influential factor was that the trainee load was too heavy for the limited training resources made available. The program had the capacity to train perhaps 70 to 80 trainees under the training conditions prevailing in FM 222; however, approximately 190 staff users, including controllers, were admitted to training. For FM 222, the classes were simply enlarged to double their capacity, and the original training schedule was followed without modification.

The second factor was that the amount of time scheduled and the training technique used for the practical exercises were inadequate. The common complaint of trainees was that they did not experience enough hands-on training and could not apply the knowledge learned from lectures by actually performing data processing operations with the computerized system. MIOD time allotted for one user had to be divided up among three or four users. Thus, some trainees actually experienced only one-fourth the amount of hands-on training they should have had. The practical exercises were designed for individual learning wherein a trainee could develop the important skills necessary for independent interaction with the computer system. In many sessions, the opportunity was not there, because the practice became merged into a group effort. Three or four trainees would gather around one MIOD, and they all would participate in working through a problem that one of them should have been doing independently. The effects of this lack of practice surfaced dramatically in the performance exam, where many trainees experienced great difficulty in structuring the problems and working them out in a logical or systematic manner.

Another weak aspect of the practical exercises identified by the trainees was that there was not enough direct interaction with the TOS software system in the training. Much of the training was devoted to the fundamental problems of message format selection, structuring the data into the format fields, and data-entry and error-correction operations. The trainees obtained little experience in how the TOS software system processed the input data, updated files, and sent the output back to the originator in a feedback loop, simulating how the actual system would function.

Trainees also acquired little experience in observing how their inputs affected various files and functions already in the system's memory, or how the new information was used with the old information under a specified set of conditions. The practical exercises did not include any practice tests similar to the final performance examination; therefore, until the final performance examination, they never faced hands-on test situations involving difficult problems that would expose their inadequacies of knowledge and skill. The performance examination was their first experience with operating the system without assistance from others. A performance examination scheduled to be given on the first examination during the second week of training was cancelled because of computer breakdown; thus the trainees were deprived of valuable information about their ability for independent operation.

The third factor was that significant percentages of trainees felt that too little time was allotted to teaching the main lessons on the ENSIT and FRENSIT files. These lessons covered a large amount of subject matter in a relatively short time. The pace of instruction was fast, and emphasis was placed on the fundamentals of each topic. Less complete coverage was given to the higher-level and more intricate application of functions during tactical operations. Trainees indicated that they desired more training time for learning the main subjects and subjects dealing with functional applications and information management.

OPERATOR STAFF USER TRAINING EVALUATION

These findings present results from measures of operator staff user training taken at different times in the test program. Ratings and evaluations were made at the end of each lesson, at the end of the training program, and again at the end of the TOS² field test.

End-of-Lesson Ratings and Evaluations

The training program for operator staff users was a subordinate part of the staff user program of instruction. It consisted of four lessons taught to a selected group of approximately 57 enlisted staff users, with the purpose of teaching operators the skills involved in moving and setting up the MIOD for operation.

Trainee Ratings. Table 12 presents a summary of the end-of-lesson questionnaire results. On the items dealing with the effectiveness of instruction, the trainee median rating of the quality of instruction was effective or very effective on all four lessons. On the items concerned with the practical exercise part of the lessons, the trainees felt they had received adequate practice in two of the lessons, and inadequate practice on the other two. Forty-three percent of the trainees indicated they had insufficient practice on the digital data terminal. On the lesson on communication methods, 30% indicated they had insufficient practice on the equipment. Most of the trainees felt that they had accomplished the lesson objectives on all four lessons and that the time allotted for each lesson was adequate.

Table 12

End-of-Lesson Rating of Instruction

Lesson	Instructional elements			Lesson time
	Instruction	Practice session	Attaining lesson objectives	
Assembly and disassembly of cabling	A	A	A	A
Digital data terminal	A	X	A	A
Operator maintenance and troubleshooting	A	A	A	A
Communication methods	A	X	A	A

Note. A indicates adequate; X indicates inadequate.

Trainee Opinions. Table 13 presents a classification and tabulation of trainee remarks in the end-of-lesson questionnaire covering the four lessons. The most frequent remark made was that there were too many trainees for the number of MIOD's available, and the third most frequent was that they needed more practical exercise time on the MIOD. These two directly related problems accounted for 52% of all the comments.

Evaluator Ratings. A summary of the median ratings of the lesson elements for the four lessons for selected MIOD operators is shown in Table 14.

Table 13

Trainee Comments on MIOD Operator Lessons

Remark	Number made	Percent distribution
Too many trainees per MIOD; class too large for amount of resources available	14	33
Distractions in classroom degraded learning conditions	9	21
Need more practical exercise on the equipment	8	19
Items of equipment nonoperational or not available	4	9
Need more detailed instruction on specific topics	3	7
Assistant instructors not available to trainees needing guidance	3	7
Instructor was a good teacher	2	4
Total	43	100

Table 14

Evaluator Ratings of MIOD Operator Lessons

Lesson element	Median rating
Lecture session	Effective
Practical exercise session	Borderline
Instructor's ability	Effective
Total lesson	Effective
Lesson objective accomplished	Yes

Evaluator Observations. In general, the evaluators noted the same problems identified by the trainees--too many trainees for the number of MIOD's available and insufficient practical exercise time on the MIOD's. There were 18 MIOD's available and 60 trainees, for a student-to-MIOD ratio of 3.3 to 1. The class instructor, who had worked with

the TOS system for several years and was familiar with the technical aspects of TOS training, held the definite opinion that the ideal trainee-to-MIOD ratio is 1 to 1 and should not be higher than 2 to 1. In addressing the practical exercise time, the evaluators stated that, with three or four trainees assigned to each MIOD, it was difficult for everyone to obtain an adequate amount of time for practice.

End-of-Training and End-of-Test Ratings. In general, the end-of-training and end-of-test questionnaires covered the same four lessons as listed in Table 12. At the end of the training, 40% of the trainees felt that there should have been more time devoted to training on assembly and disassembly of cabling. At the end of the test, 53% felt that more time should have been given to training on operator maintenance and troubleshooting.

Discussion

The purpose of this subordinate evaluation was to appraise the adequacy of the operator staff user training in preparing the trainees to perform within system specifications during the testing phases of FM 222. The evaluation indicated that the overall objective of the training was attained; however, the lack of sufficient time and equipment adversely affected training quality.

COMMANDER AND PRINCIPAL STAFF TRAINING EVALUATION

On the items dealing with effectiveness of instruction, the trainee median rating was Effective and the evaluators rated the lecture session, instructor's ability, and the total lesson as Effective. The majority of trainees stated that the time devoted to each lesson was adequate for learning; however, the evaluators rated the practical exercise session as borderline. The lesson objectives for all lessons were judged to have been accomplished.

Although this evaluation indicated that the lesson objectives were attained and that the training of the commanders and principal staff was satisfactory overall, the problem of insufficient practical exercise, as noted in the other training phases, was also noted in this phase of training.

ANALYSIS OF DEMOGRAPHIC VARIABLES

Data from all the enlisted trainees in the ENSIT and FRENST classes who completed the final examination were analyzed in a stepwise regression analysis. The sample size was 48 subjects. Table 3 lists the 24 biographical measures and aptitude scores included in the analysis as independent variables. The dependent variable was the

sum of the normalized scores from the written and performance portions of the final examination.

Results

Table 15 presents the results of the stepwise regression analysis. Of the 24 independent variables, 4 were found to have significant, positive correlations with the examination score. The combination of all four variables accounted for a significant proportion of the total variance in the examination scores ($F = 11.72$, $df = 4/42$, $p < .001$). The value of the coefficient of determination R^2 equaled .5275, which means that approximately 53% of the variance of the examination scores was accounted for by the four attribute variables in combination--the GT, primary MOS, CO, and SC.

Table 15

Summary of Stepwise Regression Analysis for Data from
MIOD Operators in ENSIT and FRENIT Classes

Variable entered	df	F to enter	Increase in R^2
GT (general technical)	1/42	21.15	.3198
Primary MOS score	1/42	8.26	.1075
CO (combat)	1/42	4.44	.0536
SC (surveillance/comm)	1/42	4.15	.0466
Value of R^2	--	--	.5275

The last column in Table 15 gives the proportions of variance due to the individual variables. These results show that when the four variables are taken together the GT score is the most powerful predictor and accounts for about 32% of the variance. The primary MOS score accounts for about 11% of the variance, and the combat (CO) and surveillance and communications (SC) scores account for about 5% each of the variance. It appears that all four attribute variables are meaningful predictors of MIOD operator training proficiency. Since the effort and expense are virtually equivalent for obtaining any one of these scores, or all four, it would be advantageous to use them all to maximize predictive power.

Discussion

This analysis suffers from one major weakness: The sample size may not have been large enough to insure high reliability of the results. (The method of multiple regression analysis is known for its low reliability, and that problem is minimized by using large samples.) Kerlinger and Pedhazur² noted that some authors recommend that the sample size be at least 30 subjects per attribute variable. In this analysis, the advice calls for a sample size of 120 rather than the 48 that was used. Since our sample may not have been sufficient, the results should be viewed as preliminary findings that have uncovered four attribute variables that show promise as predictors of aptitude for TOS operator staff user training.

²Kerlinger, F. N., & Pedhazur, E. J. Multiple Regression in Behavioral Research. New York: Holt, Rinehart, and Winston, 1973.